STATISTICAL STANDARDS IN BUSINESS RESEARCH

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I. INTRODUCTION

The great war furnished the occasion, if not the motive, for business and economic prescience. It served to dignify facts and to direct the uses to which they were put. Largely due to the war, the case for business and economic planning has been won and the function of fact analysis in business has been demonstrated. The excuse for the organization and the point of view which the war developed are no longer present, but the need remains. Somehow or other, the gains secured to business, industrial, and economic research must be preserved, and the scope of research must be broadened and the method improved. A sufficient sanction for the accomplishment of these ends must be discovered and applied.

Industry has adopted a new point of view. Laboratories for experimentation are now found in the largest industrial establishments. Research under some auspices is being extended to the physical and chemical fields; to purchasing and selling methods; to production time- and motion-study; to behavioristic psychology and employment management; to market breadth, depth, and elasticity; to phenomena of prices and costs, and to the factors by which market fluctuations may be anticipated and uncertainties discounted. Hardly a week passes without the establishment within some business of so-called research departments, or the organization of private agencies for research purposes. Problems of personnel, marketing, costs, industrial relations are all being subjected to some sort of analysis. How scientifically this work is being undertaken, how completely the motive and methods are influenced by considerations of profits, it would be impossible to determine without an analysis of each unit. Such an analysis, although it may be needed, cannot be made here. The purpose of this paper is less comprehensive and, it is believed,

more important at the present time. It is to formulate in brief compass some of the more fundamental statistical standards of business research, and to suggest the content of scientific method when applied to the study of business problems. It is not to enumerate a series of rules of procedure covering the different stages in statistical analysis. To do this would be to repeat what has been written elsewhere. The broader task is attempted with the hope of contributing something to the technique of scientific method when applied in business research.

The method of treatment is *first*, to state the case for research in business fields; *second*, briefly to explain the research point of view and method, with special application to business problems; *third*, to formulate the standards to which research must conform throughout the different steps in statistical analysis. This is done by considering (a) standards for business facts, (b) standards for collection or summation, (c) standards for classification and tabulation, (d) standards for graphic representation, (e) standards for interpretation, (f) standards of organizations for research purposes when research is undertaken as a regular part of university work.

II. SCIENTIFIC METHOD AND BUSINESS RESEARCH

Research involves both a point of view and a method. The point of view is an unconditional demand for the truth; the method is (1) intelligent observation, (2) scientific measurement, (3) impartial analysis, (4) logical inference, and (5) sincere application of the conclusions reached to the problems to which the facts and observations apply.

Scientific method has been defined as a state of mind, and this is probably a true characterization if the qualification is added that the point of view which it represents is consistent in seeking the truth, and in being guided by facts, not at one time, in one place, or under one condition, ignoring them when it becomes advantageous or when they are difficult to determine, but in all places, at all times, and under all conditions. To the fact analyst, imbued with the spirit of scientific method, facts are facts. They are welcomed for the truth which they contain. The attitude toward them and toward the changes

which they make imperative, or the beliefs or customs which they challenge, is positive, receptive, and open-minded; not negative, doubtful, and hesitant. It is not a little truth, but the whole truth, which is desired. The essence of science is not so much in its content or in its product as it is in its method.

Research implies a laboratory from which facts may be secured or in which they may be developed. Because of the frame of mind which the war developed and nurtured, business today, in many respects, constitutes an ideal laboratory. Merely as the result of daily operations, great masses of comparable facts which may be statistically expressed are currently developed. Some of these are crude, it is true,—they are "in the rough." This is especially so in small businesses where accounting principles are neglected or ignored, or where competition, state control, or public necessity has not required comparable records to be kept. In the larger industries, however, where markets are wide and competition severe, and where large-scale production, utilization of waste, and the creation of by-products is the rule, the facts are far more nearly satisfactory. Not for all purposes, of course, for no business fact, however carefully prepared, is equally good for all purposes. Definition, measurement, and use are interrelated; they cannot be divorced from one another. The field for business research is ready or in preparation; the sanction for research is daily being extended to private and public agencies. This sanction must neither be abused nor destroyed.

There are two approaches to business analysis or research which, for convenience, may be described as the *inside approach with an outside perspective*, and the *outside approach with an inside significance*. The discovery of business principles, the measurement of business success, the anticipation of business difficulties, and the elimination or adjustment of business risks and friction are the ends sought in both approaches. The methods employed and the facts considered are different, more in their scope than in their essential nature.

Research addressed to *inside facts with an outside perspective* extends to costs, sales, markets, credits, production methods and control, personnel, wages, and conditions of employment. Its purpose is to eliminate waste of materials, money, and

effort; to increase production and sales, and to decrease costs. Its end is narrowly pecuniary; the motive which prompts it, acquisitive; and its results are generally of restricted consumption. The increase of profits is its *raison d'être.*

Research addressed to *outside facts with an inside significance* proceeds differently. Individual experiences are lost in the totality of experiences as they are shown in *trends* of production, earnings, costs, prices, credit, wages, population growth, concentration, etc. The aim is not so much to secure an immediate increase of profits as it is to measure or to anticipate demand, to forecast change, to bridge the gulf between the present and the future, and to measure and to correlate the economic and social forces which determine business growth and decline. The long-time viewpoint and the study of fundamental causes and effects are the controlling factors. Obviously, the results of this type of research, if it accomplishes its end and its results are utilized, may be as narrowly pecuniary as the results of the other. The facts observed are much the same, but the approach is different. The methods followed, in so far as they are scientific, are identical. Scientific method knows no variation; it does not find its justification in the salability of its product.

These two phases of business research are complementary. For those who are studying business from the outside to lose sight of the inside facts is unscientific; for those who are studying the inside facts to fail to appreciate their outside significance is without justification. "Inside" and "outside" are simply different points of view. Acquisitively, the inside perspective seems to be more important; socially, the outside looms the larger.

III. BUSINESS FACTS—STANDARDS TO WHICH THEY MUST CONFORM

The measurements of business facts, statistical or otherwise, are always relative; they require the use of both a unit and a standard of measurement. Standardization in measurement implies homogeneity; it suggests conformity and suitability to conditions determined in the light of particular application. Measurement involves not only an application of a unit of

measurement, but also an interpretation of the results obtained from the application. Things which are equal to each other in name are often not so in use or in meaning. The meaning of a measurement of a business fact is a function of the use to which the measurement is put. The point which is being made is that the meaning, use, and measurement of business facts cannot be dissociated. Scientific method requires that business problems be broken up into their various parts, that they be measured by standardized units, and that comparisons between them rest upon common qualities.

As a basis for the application of scientific method to business problems, statistical units must, *first,* be homogeneous. Characteristics that are significant for the purpose for which facts are to be used, must not be ignored. It is, of course, impossible to secure perfect homogeneity. It is not impossible, however, to classify differences according to the significance that these have for particular uses. After all, homogeneity is simply relative. Differences that are significant from one point of view may be ignored from others. Statistical methods require that facts, as well as the differences that characterize them, shall be classified, and that the bases of classification for both shall be chosen according to the significance which they have for particular uses.

Second. Statistical facts must be *representative.* Facts that, because of the ignorance or design of those who collect or use them, do not meet this condition, are an uncertain base upon which to formulate business judgments. Where bias rules, occasions for error exist. It is immaterial whether bias results from wilful elimination of a part of the facts, from basing conclusions on insufficient or unrepresentive data, or from comparing periods and conditions that have nothing in common. When business problems are approached scientifically, truth is desired and every effort must be made to secure it. It is the function of facts to reveal the truth, not to conceal and distort it.

Third. Facts must *fit;* they must be germane. Here, the consideration is not primarily of measurement, but rather of interpretation. Ignorantly or wilfully to select facts at random and without definite purpose in order to support a con-

tention, or to excuse or develop a business policy, violates every phase of scientific method. Both intelligent observation and logical inference are sacrificed. The fundamental principle which requires that every fact be referred to the condition which can produce it, is violated.

Fourth. Facts must be *stable.* They must relate to purposes and conditions that are essentially uniform. While absolute uniformity is unthinkable, essential uniformity is possible of realization. Business judgments based on exceptional or erratic observations, conditions, or periods, are unstable. It is necessary to distinguish between short- and long-time influences, between exceptional and normal relationships, between periods of decline and periods of growth, between cyclic and secular trends, between transitory phases and permanent tendencies. Business facts and relationships are constantly changing. In some, fluctuations are rapid; in others, infrequent. In some, they are sporadic; in others, they are periodic. The measurement and interpretation of facts must be adjusted to time, place, and condition.

Fifth. Both the facts themselves and the conditions of measurement must be *comparable.* Like can only be compared with like. Shifting conditions of measurement and changing units cannot be tolerated. The measuring stick and the method of applying it must be uniform for all measurements.

Sixth. Facts must be *accurate.* Accuracy is affected by the conditions under which facts are reported and collected, by the unit which is used, and the method by which it is employed. Absolute accuracy in most lines of research is unthinkable; essential accuracy is generally realizable. Business facts, like others, are generally variates, the measurements serving merely as sufficient approximations to an ideal. In the matter of price changes, Dr. Mitchell has forcibly called attention to this fact.

Statistical standards of accuracy allow for the corrective elements of chance and give free play for the operation of the "law of averages." Biased errors of unknown amounts and direction are disturbing, but unbiased errors, subject to chance distribution, are of little significance when problems are studied in the aggregate or as totals. But to expect errors

always to be compensating, and truth always to emerge from a tissue of falsehood is to be too sanguine. "The other things" which one so confidently hopes will remain "equal," rarely so behave for business phenomena. That caution which urges one to stay close to the original data, verifying truths and correcting errors, is no less applicable to statistical than it is to any other form of research.

Such are the statistical standards to which business facts must conform. The degree to which they have been realized in statistical facts will determine the standards of collection, analysis, and interpretation to which they may be subjected.

IV. STATISTICAL STANDARDS IN THE COLLECTION OF BUSINESS FACTS

Business facts constitute the raw material for business research. They are developed in the routine processes of sales, production, employment, accounting control, and administration. Business relationships, policies, and principles are founded upon them. How may they be secured for research purposes? What are the standards which should govern their collection or summation?

First. Business facts must be collected for a definite purpose. Statistical analysis cannot proceed as if it were in a vacuum; the meaning of a statistical fact is dependent upon the use to which it is put, and the costs of collection are justified only in the realization of a purpose. For collection to proceed without a definite goal in mind is not only wasteful of time and money, but fatal to the idea of research. Facts are not equally good for all purposes. The acts of measurement and of classification presuppose a purpose. To ignore this truth is to proceed unscientifically. Fruitless investigations, carried on at enormous costs and resulting in ill-will on the part of those who are interested in the results, discouragement on the part of those who are undertaking them, and a tendency to scout the idea of research and the function of experts, are largely if not solely traceable to a violation of this seemingly self-evident truth.

Second. Business facts must be collected in standardized units and under uniform methods of application.

Third. A sufficient sanction for the collection or use of data must be secured. To formulate a definite purpose for which facts are desired is the first condition for securing this. It is generally, but not always, necessary to demonstrate that personal advantage will result from a study of the facts furnished. But more than this narrow appeal may be made. Research for its own sake, or in cases in which the results are not capable of immediate capitalization, now appeals to business interest. There is a remarkable tendency for interest to center in a study of principles. "The study of fundamentals" is a business watchword today. Sanction may be secured through coöperation. Research may be made not only *of* business but *with* business. Sanction may be secured not only by granting that facts will be made available for use, but also by insisting that a representative body of the industry or interest studied shall be appointed with which the research organization may and should constantly consult.

Fourth. Standards of collection require that the full import of such questions as the following shall be considered: (1) For what periods, under what conditions, and for what places are the facts available? Are the purposes and methods of research conditioned by the answers secured? (2) Will *available* facts be given, or may they be assembled; and if so, in what units, with what degree of accuracy, and with what effect? (3) Do the schedules or forms used in collection provide for keeping confidential the data supplied? (4) Are the units of measurement which are employed standardized and understood? Do they follow or run counterwise to the terminology of the records employed? How may necessary adjustments be made, and with what effect?

Fifth. Statistical standards require that wherever possible the truth or error of business facts shall be verified. Against the imputation of gullibility, those in charge of research should always be capable of defending themselves. To take on faith the plausible, or to discard seeming exceptions, is not in keeping with scientific method. Verification requires more than testing mechanical accuracy and removing apparent inconsistencies. It involves an analysis of the composition of groups and totals, and a scrutiny of the uniformity of measurement

and the methods in which units are applied for different times, places, and conditions.

Sixth. The field from which data are secured must be adequate and the facts inclusive or representative. The choice of the field and the selection of the facts depend upon the purpose for which research is undertaken. A problem requiring inclusive data must be approached differently from one which may be studied by means of samples. Standards of collection may, indeed, become standards of elimination; and balance and consistency, rather than merely the verification of accuracy, may become the goal.

V. STATISTICAL STANDARDS IN TABULATING BUSINESS FACTS

Tabulation is a means, *first*, of recording in fixed form a classification previously developed, or, *second*, of placing similar facts in juxtaposition or in groups as a preliminary to a final classification. It is a device for projecting on a surface, capable of being read in two dimensions, a classification which has been worked out, or is being worked out. It is a method of recording a process of thought. It is inelastic in structure; the facts which it contains are in truth "locked up." Classification precedes; tabulation follows. The sequence of thought is from purpose to method.

The statistical standards to which tabulation must conform are as follows, and here again it is necessary to repeat that it is not the purpose of this paper to formulate a set of rules governing the make-up of tabulation forms, but rather to develop the statistical standards in tabulation which lie back of the rules, the realization of which may require a variable technique.

First. Every tabulation surface should faithfully record the classification which it is intended to depict. The purpose of tabulation and the standard to which it must conform cannot be divorced.

Second. There is always a *best* form of tabulation for a given purpose, as there is a most logical basis of classification. Indiscriminate choice of forms is as much without justification as is a meaningless or superficial classification.

Third. Every tabulation should be adjusted in form and complexity (a) to the subject matter which is to be expressed,

and (b) to the person for whom it is prepared, or to the end to which it is addressed.

Fourth. The order of detail in tabulation forms should be adjusted so as to be emphatic. It should be natural, not artificial; convincing, not purposeless.

Fifth. Statistical tables should carry only relevant data. The reciprocal relation between relevancy of fact and the purpose to be accomplished by tabulation, is the thought which is stressed.

Sixth. Statistical tables should carry on their face both their justification and their explanation.

Seventh. The details of statistical tables should be mechanically accurate, and their grouping and arrangement consistent, logical, and serviceable.

Eighth. The natural order in classification is from detail to summary; the serviceable order in tabulation is from summary to detail.

Ninth. Brevity is said to be "the soul of wit." It is equally true that conciseness in tabulation is the secret of its effectiveness for business purposes.

VI. STATISTICAL STANDARDS IN THE GRAPHIC PRESENTATION OF BUSINESS FACTS

The excuse for the use of graphics in business research is largely if not wholly their universal appeal. Graphs speak a common but frequently an inarticulate and confused language. There is an attractiveness about them which is alluring but often deceptive. Their appeal is visual and instantaneous, not necessarily reasoned and reflective.

Again distinguishing between rules for graphic presentation and the standards which give pertinency to the rules, the following standards may be formulated:

First. A statistical fact and its form of representation should agree. By this single standard, deception, whether resulting from a confusion of the apparent with the real, or of the superficial with the fundamental, is fully provided against. The object of business research, as it is in all research, is the establishment or determination of truth. Standards for graphics provide for their use in influencing but never in deceiv-

ing men. In spite of the standards adhered to, however, both results may be accomplished by the same graphic device. "It is their appeal, their smug finality, which suggests their virtues and at the same time conceals their weaknesses."

Second. Graphic forms should be selected according to their psychological appeal and their ease of comprehension, care always being taken not to violate the first standard.

Third. Graphic forms should be chosen in accordance with (a) the form and complexity of the subject matter illustrated, and (b) the type of consumer for whom they are intended, or the purpose which they are designed to serve.

Fourth. Graphic devices should be considered more as illustrations of analysis than methods by which analysis is made.

Fifth. Graphic figures should be drawn as accurately as a visual representation will permit. Accuracy, of course, is never absolute. In graphics, the realization of relative accuracy of each part and of the totality is the standard set. To this standard, a corollary is needed; graphic forms should always be accompanied by the original data which they represent.

VII. STATISTICAL STANDARDS IN THE INTERPRETATION OF BUSINESS FACTS

All forms of research involve an application of the scientific method. But business research offers peculiar difficulties. In far too many cases, it is undertaken for profit and influenced by conditions of profit. It is seriously undertaken today and overthrown tomorrow; adopted in one line of endeavor and scouted in another. It is undertaken by fits and starts, first welcomed and then dismissed. The results are too frequently given a narrow interpretation and are restricted to purely inside affairs without an appreciation of their intimate relations to outside facts. Business and industry are too often considered as made up of independent units, or as involving separate problems, sections or individual aspects of which may be studied separately, and the facts concerning them independently interpreted. For instance, those engaged in research in time- and motion-studies have only lately, if at all,

come to appreciate the fact that men, not automatons, are under the microscope.

Business is complex and so must be the interpretation which is given to business facts. To look for a single meaning in, and to expect a single consequence to follow from, a group of business facts is to be grossly unscientific

Given a related group of business facts which have been collected, tabulated, and graphically expressed according to the conditions that have been formulated, to what standards must an interpretation of them conform? To fail to attach meaning and significance to them as bases for business policy and foresight, is merely to accentuate the all too prevailing practice of leaving untranslated into business standards and principles the myriads of facts daily growing out of, or experienced in, business relations.

Some of the fundamental standards of interpretation are as follows:

First. The truth is the end sought; error is not to be disguised, falsehood tolerated, or preconceptions favored.

Second. Comparisons can be made only between things, conditions, times, and places having common qualities.

Third. In interpretation, facts must always be referred to conditions which can produce them.

Fourth. Interpretation should extend to an explanation of the past and a forecast of the future. For business purposes, facts are more significant as bases for planning future policy than for explaining or justifying past action.

Fifth. Distinction should be made between long- and short-time conditions and consequences; between transitory skirmishes and general tendencies.

Sixth. Avoid the error of confusing the results of a single cause with the results of a combination of causes; of identifying proximate and remote causes; and of expecting a single cause always to give rise to a single effect. A given cause is not an homogeneous thing except when viewed in the broadest way. The effects which seem to follow from it do not come as an undifferentiated whole, but as variations. Some come as coincidences; others, as sequences spread over long or short periods. Both cause and effect are in reality variates.

Seventh. Distinction should be made between drawing a particular deduction and giving it general application.

Eighth. Similarities and differences should be appraised in the light of particular application. Similarities that are complete for one purpose are incomplete for others; and differences that are fundamental for one purpose often may be ignored for others.

Ninth. The detail of interpretation should conform to the nature of the problem and to the capacity of those interested. Not infrequently an exaggerated accuracy, which the nature of the basic data does not justify, or the occasion for summarizing warrant, is worked out in meticulous detail by means of percentages, averages, and other summary expressions. Similarly, far-reaching conclusions are sometimes drawn from inadequate data by elaborate and over-refined methods. Statistical analysis then appears as an inverted and unstable pyramid.

Likewise, involved and complex interpretations are sometimes prepared for those who are statistically ignorant of refined processes, or for those who are disinclined to follow or are uninterested in pursuing an elaborate analysis. A statistical interpretation designed to influence executive action or to enlist administrative support is rarely, if ever, to be couched in the same language or to include the same detail as one which is intended to serve the simple purpose of record. Consumers of statistics differ not only in their statistical interests but also in their statistical horizons.

VIII. ORGANIZATION FOR BUSINESS RESEARCH

The goal set by research organizations in the study of business facts and practices should be to realize for each of the steps in analysis, the standards which have been enumerated. No one form of organization is best suited to accomplish this for all purposes. The relation of purpose and method is as significant in this respect as it is for the other aspects of research. A simple analysis, extending only to the surface phases of business problems, may be made by loosely formed and unscientifically disposed organizations. On the other hand, a comprehensive analysis, extending to the deeper

significance of business facts and practices, requires a correspondingly elaborate and scientifically inclined organization. The one indispensable condition that must always be met is that imposed by the standards of the scientific point of view. The requirements of this standard are of universal application; the way in which they are to be realized varies in each organization according to the scope of the problems that are studied and the required technique.